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INFORMATION SYSTEM EXPERTS: DEFINITION, IDENTIFICATION, AND APPLICATION

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Abstract

Experts' views and commentary have been highly respected in every discipline. However, unlike traditional disciplines like medicine, mathematics and engineering, Information System (IS) expertise is difficult to define. Despite seeking expert advice and views is common in the areas of IS project management, system implementations and evaluations. This research-in-progress paper attempts to understand the characteristics of IS-expert through a comprehensive literature review of analogous disciplines and then derives a formative research model with three main constructs. A validated construct of expertise of IS will have a wide range of implications for research and practice.

Keywords: Expert, Novice, Intermediate, System evaluation, Knowledge, Experience

1 Introduction

Views of the experts are commonly sought in almost all disciplines, in general to improve our understanding of a phenomena. Organizations and individuals seek such advice from experts as a regular occurrence in our day-to-day life. In some disciplines, identifying an expert is somewhat easier than in other disciplines due to recognized employment classifications and restricted number of roles. For example, in medicine, only registered medical practitioners are allowed to provide medical advice. The expertise of the person in the aforementioned example is tested and recognized through a set of examinations set by a medical association. In social science disciplines, where IS is an archetype of, identification of an expert (and expertise) through test using the classical test theory has substantial limitations and operational deficiencies. Thus, several other classifications are proposed by social scientists in the past three decades (Schvaneveld, Durso et al. 1985; Leplat 1986; Glaser and Chi 1988; Ericsson and Charness 1994).

Social science research demonstrates that expertise (as a positive indication of degree of proficiency) is not a reflection of ones innate abilities and capacities, but rather a combination of acquired complex *skills, experience* and *knowledge capabilities* (Ericsson and Smith 1991; Hunt 2006; Norman 2006; Yates and Tschirhart 2006). Many social scientists have demonstrated the positive impact of extended deliberate practice and the impact of deliberate learning of skills on ones performance of a task (Eriksson, Krampe et al. 1993). Similarly, heuristics have been established on the approximate number years in deliberate practice to attain a high level of expertise (Simon and Chase 1973). Since early comparisons of the performance of experts and novices in social psychology (Chase and Simon 1973; de Groot 1978), research on ‘degree of proficiency’ has played an important role in management and social science disciplines.

Despite strong research from social psychology on expertise gained through ‘years of experience’ and ‘deliberate practice’, research has been lacking on several pertinent areas. Our review of literature suggests a strong need for research on three important aspects: (1) what salient ‘knowledge types’ are required to attain expert performance, and (2) how the generic ‘socio-behavioural factors’ contribute to ones expert performance. Moreover, many prior expertise studies have been completed in static disciplines (e.g. sports and mathematics), where practice and experience take precedence over the knowledge held by the individual. However, (3) in dynamic social science disciplines like Information Systems (IS), where changes are frequent, years of experience and deliberate practice may not have a substantial impact on ones performance. In dynamic disciplines, salient knowledge held by individuals tautologically should have a far greater influence on the expert performance.

Employing the aforementioned prepositions, this research attempts to define the salient characteristics of expertise in the discipline of Information Systems. In doing so, we derive insights from the Generalized Expertise Measurement (GEM) of Germain (2009), Knowledge types of Davenport (1998), years of experience research by Simon and Chase (Simon and Chase 1973) and conceptual work on the degree of proficiency by Ericsson et al. (1991). The formative model of expertise will then be derived using the salient constructs that would purportedly measure expertise of an individual in Information Systems. Since each of the constructs makes a unique contribution to expertise, the research model conceives the phases as dimensions ‘forming’ expertise. The expertise model is thus conceived and operationalised as a hierarchical, multidimensional, formative index (arrows pointing in). The derivation of the model would facilitate the identification of three levels of expertise based on their degree of proficiency: novice, intermediates and experts; where an ‘expert’ holds the highest degree of proficiency, followed by intermediate and novice. Once the model is derived, we explore the methods of identifying experts through various methods. We investigate the pros and cons of the two popular methods of classifying expertise: (1) the classical approach and (2) the self-classification method. Finally, the paper identifies areas in IS where such a classification of expertise can be usefully employed.

The paper proceeds in the following manner. The paper begins with a definition of expert, followed by a critique of related literature to derive the salient characteristics of an expert. Next, the paper discusses the two main methods of identifying an expert. Subsequently, the paper alludes to the areas where such a classification is useful in the IS discipline. The paper concludes with a discussion on construct validation and implications for research and practice.

2 Defining an Expert

Consistent with prior studies in parallel disciplines, this study commences with the tentative definition of expert as one with “acquired complex *skills, experience* and *knowledge capabilities*” (Ericsson and Smith 1991; Hunt 2006; Norman 2006; Yates and Tschirhart 2006). Expertise is defined as superior performance in terms of success, swiftness, and/or accuracy. Experts have prolonged or intense experience through practice and education in a particular field and they are able to deal with new situations in their domain. (e.g. (Schvaneveld, Durso et al. 1985; Leplat 1986; Glaser and Chi 1988; Ericsson and Charness 1994). Moreover, an expert has recognized knowledge and expertise who can comment authoritatively on an issue and often is asked to give an opinion with regard to the specific facts (Bainbridge 1989; Olsen and Rasmussen 1989). Experts seem to have prolonged or intense experience through practice and education on their field of expertise. In contrast, a novice has only factual and free-context rules acquired from training and is typically at the early stage of the career (Dreyfus 1992). Lying between two extremes is an intermediate. It is common practice in management discipline to employ the ‘years of experience’ as the sole indicator for determining the degree of proficiency. It is also highlighted that in specific fields, the definition of expert is well established by consensus and therefore it is not necessary for an individual to have a professional or academic qualification for them to be accepted as an expert.

3 Characteristics of an Expert

The salient characteristics of an expert are derived through the key concepts of the aforementioned definitions. The levels of expertise, also known as the ‘degree of proficiency’, is generally associated with skills, expertise and knowledge, which extends over a continuum, from *novice* → *intermediate* → *expert*, where an ‘expert’ holds the highest degree of proficiency (Eriksson and Charness 1994). Expertise, in general, is defined as superior performance in terms of success, swiftness, and/or accuracy. In between two extremes of experts and novices are the intermediates. The following review of literature describes aspects that have been discussed in social science discipline describing the degree of proficiency. It first introduces ‘Years of experience’ and ‘Deliberate practice’ as two of the most commonly used constructs in determining ‘expertise’. The review then introduces ‘Knowledge’ as an important construct for Information System expertise. Thirdly, the review provides a summary of findings on the methods of identifying experts in a subjective self evaluation.

3.1 Years of Experience

‘Years of experience’ is one of the most common researched constructs in association with the level of expertise. Social Science research on expert performance and expertise (Chi, Glaser et al. 1988; Ericsson and Smith 1991) has shown that important characteristics of experts' superior performance are acquired through experience arguing that exceptional performance is an outcome of the environmental circumstances, such as the duration and structure of activities¹. Eriksson et al. (1993) hypothesized that the individuals’ performances are a monotonic² function of the deliberate practice. They argued that the accumulated amount of deliberate practice and the level of performance an individual achieves at a given age is a function of the starting age for practice and the weekly amount of practice.

¹ Research demonstrates that some minimal biological attributes may also lead to the acquisition of expertise. This is considered beyond the scope of the study.

² Changing in one direction only; thus either strictly rising or strictly falling, but not reversing direction.

The view that merely engaging in a sufficient amount of practice, regardless of the structure of that practice, leads to maximal performance has a long and contested history and is demonstrated in a series of classic studies of Morse code operators. Bryan et al. (1897) and Bryan et al. (1899) identified plateaus in skill acquisition, when for long periods subjects seemed unable to attain further improvements. However, they observed, with extended efforts, operators could restructure their skill to overcome plateaus. Keller (1958) later showed that these plateaus in Morse code reception were not an inevitable characteristic of skill acquisition, but could be avoided by different and better training methods.

Though it is tautological that 'years of experience' is related to and at times influences the degree of proficiency, such a proficiency-classification that is purely based on the years of experience, for contemporary IS may lead to inconsistent interpretations. Such a simple classification based solely on the number of years would be unreasonable, especially given that a contemporary IS includes many user cohorts ranging from senior managers to data-entry operators - each cohort with a diverse set of skills and capabilities. In parallel disciplines, it has been established that it takes ten-years to become an expert from the time at which practice was initiated (Simon and Chase 1973). Simon and Chase's (1973) "10-year rule" is supported by data from a wide range of domains: music (Sosniak 1985), mathematics (Gustin 1985), tennis (Monsaas 1985), and swimming (Kalinowski 1985). Given that Simon and Chase's 10-year rule has been generalized in a range of disciplines, it is intriguing to evaluate whether the same findings are generalized in Information System discipline as well.

3.2 Knowledge contributes to expertise

Germain (2006) describes knowledge as an integral aspect of one expertise. In the knowledge management stream of literature in IS discipline too there is strong recommendations for end-user knowledge for system success (Davenport 1996; Davenport 1998; Davenport 1998; Gable, Scott et al. 1998; Bingi, Sharma et al. 1999; Sumner 1999). Research suggest that managing a contemporary Information System as a high knowledge intensive task that necessarily draws upon the experience of a wide range of people with diverse skills and knowledge capabilities (Gable and Klaus 2000; Soh, Sia et al. 2000). Davenport (1998b) identifies three types of knowledge that are necessary for managing contemporary Information System lifecycle: (1) software-specific knowledge, (2) business process knowledge and (3) organization-specific knowledge. The three types of knowledge project the complete breadth of knowledge capabilities required for an end-user in an IS and provide the foundation for defining the characteristics of an expert in IS.

Software specific knowledge refers to the knowledge, skills and expertise that those employees' possess in relation to the operation of the system features and functions. Business process knowledge refers to the in-depth understanding of business possesses that the employee engages with. Davenport (1998) asserts that business process knowledge of an employee should reflect not just the functional area that s/he is involved in, but the entire business process that one is engaged in. Moreover, similar to prepositions by Kaplan and Norton (1996), and in light of Davenport's (1988) arguments on types of knowledge, employees' organizational knowledge too is vital in defining ones expertise. Organizations of the 'knowledge-era' focus on increasing effectiveness through establishing strong foundations in knowledge, which includes not only software knowledge but employees' knowledge of business processes and work practices. Akin to Xu et al., (2003), we argue that most (if not all) business processes are situational in nature, where the software is adapted to meet needs of specific business circumstances. In light of the aforementioned, it is argued that the two knowledge types of an IS employee are largely responsible for the degree of proficiency.

Moreover, in general (and regardless of the study context), 'training' has been identified as a critical aspect that contributes to employees' knowledge. Such formal training programs ensure wider distribution of highly context-specific knowledge that can be particularly useful throughout the phases of an IS lifecycle (Pan and Chen 2005). In the interest of understanding the contribution of formal

training on software and business knowledge, this study includes 'formal training' as an antecedent of overall knowledge.

4 How to identify experts

Having established the salient characteristics of experts, we now attempt to discuss methods of identifying an expert prominent in the literature. In research of social science disciplines, there exist two main methods in identifying an expert: (1) classical test theory approach, and (2) self-classification approach.

4.1 Classical Test Theory Approach

The classical test approach attempts to identify ones expertise using the role of long term memory in the skilled memory. This was first articulated by Chase and Simon in their classic studies of chess expertise (1965). They asserted that organized patterns of information stored in long term memory (chunks) mediated experts' rapid encoding and superior retention. Their study revealed that all subjects retrieved about the same number of chunks, but the size of the chunks varied with subjects' prior experience. Experts' chunks contained more individual pieces than those of novices. This research did not investigate how experts find, distinguish, and retrieve the "right" chunks from the vast number they hold without a lengthy search of long term memory.

Classical test theory is regarded as the "true score theory." The theory starts from the assumption that systematic effects between responses of examinees are due only to variation in ability of interest. All other potential sources of variation existing in the testing materials such as external conditions or internal conditions of examinees are assumed either to be constant through rigorous standardization or to have an effect that is non-systematic or random by nature (Van der Linden & Hambleton, 2004).

This approach requires one to have an objective body of knowledge into a set of prepositions whose truth of false. The classical test approach works on three principals: (1) The first principle of skilled memory, the *meaningful encoding principle*, states that experts exploit prior knowledge to durably encode information needed to perform a familiar task successfully; (2) the second principle, the *retrieval structure principle* states that experts develop memory mechanisms called retrieval structures to facilitate the retrieval of information stored in long term memory; (3) the third principle, the *speed up principle* states that long term memory encoding and retrieval operations speed up with practice, so that their speed and accuracy approach the speed and accuracy of short term memory storage and retrieval. Despite its long establish foundations in fields like mathematics, sports and medicine, the classical approach cannot be applied in social science disciplines like IS, given that answers in such disciplines are highly dependent on the context.

4.2 Self Classification

As the name suggests self-classification is the process of looking at the self in order to weigh up aspects that one may be asked to evaluate on. The self-reporting approach³ of Vogotsky (1962), a survey instrument is devised on the salient characteristics of expertise and the respondents are asked to respond to a series of survey questions rating their own knowledge, expertise and / or skills. Though there are some limitations where respondents may overstate or understand their level of expertise, research suggests that self evaluations provide a reasonable depiction of the reality.

³ As opposed to the classical test theory approach as per works of Novick, M. R. (1966). "The axioms and principal results of classical test theory " *Journal of Mathematical Psychology* 3(1): 1-18

and Lord, F. M. N., M. R. (1968). *Statistical theories of mental test scores*. Reading MA, Addison-Welsley Publishing Company

Classical test theory requires a set of fixed prepositions in a situation. It is difficult to employ such a technique in any of the social science disciplines where a definite answer to an issue is rare.

Following Vogotsky (1962), Eriksson et al. (1994) suggest the statistical term *outlier* as a useful heuristic for identifying an expert. They suggest that, usually, if a person is performing at least one or two standard deviations above the mean level in the population, that individual is said to be performing at the expert level. Similarly, when one performs below one or two standard deviations below the population mean, they fall into the category of ‘Novice’. The remaining respondents are classified as the ‘Intermediates’. Elo (1986) too makes similar observations in relation to Chess ratings, where an expert is determined using two to three standard deviations above the mean.

5 Research Model development

Having discussed the salient characteristics and the criteria for identifying the degree of proficiency and the level of experience, figure 1 graphically depicts the relationship between the key variables. The solid line in figure 1 depicts the degree of proficiency gained through the years of experience and the innate ability; where the dotted line suggests the likely higher levels of degree of proficiency based on training and attainment knowledge requirements (in addition to the innate abilities and the years of experience).

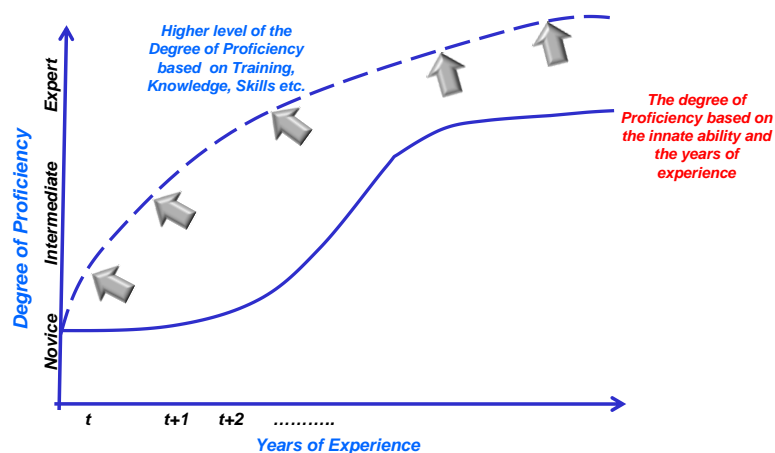


Figure 1: Relationship between the key variables

As per the Petter et al. (2007) guidelines for identifying formative variables, measures of expertise; (i) need not co-vary, (ii) are not interchangeable, (iii) cause the core-construct as opposed to being caused by it, and (iv) may have different antecedents and consequences in potentially quite different nomological nets. Expertise herein is conceived of as a construct that encompasses the *three* constructs identified above (knowledge possessed by the respondent, years of experience, and socio-behavioural attributes of the respondent).

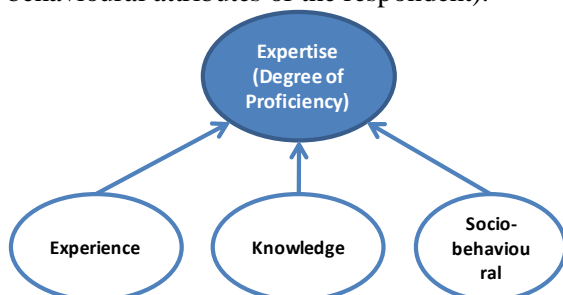


Figure 2: High-level research model

6 Application

Once the degree of proficiency of an employee (end-user) is identified, application areas are numerous. From an organizational view point, having employees with highest degree of proficiency would necessarily contribute to higher productivity levels. Thus, emulating such characteristics and behaviour of experts for intermediates and novices would be tautological. Moreover, once the degree of proficiency levels of an IS employees are determined, organizations could deploy special training and development courses for further up-skilling of all three cohorts. In this research, we are specifically interested in using views of experts for system evaluation purposes.

In IS evaluations (commonly known as IS success with the most prominent model developed by DeLone and McLean 1992; 2003 and Gable Sedera Chan 2008), respondent's characteristics has been recognized as an important consideration. The respondents' perspective is the first question of the seven questions by Cameron and Whetten (1983). However, most system evaluation studies do not pay a close attention to the characteristics of the respondent. It is our belief that an expert is able to provide a better and more insightful evaluation of a system. Thus we argue herein that organizations will benefit by paying close attention to system evaluations of 'experts'. We selected the IS-Impact measurement model of Gable Sedera and Chan (2008) that employs 27 measures arranged under 4 dimensions to assess the level of success of a contemporary IS for this purposes. It is our expectation that by including a To the extent that the three groups demonstrate statistically significant differences argue for the existence of the three degrees of proficiency: novice, intermediaries and expert.

7 Construct validation and research implications

As stated above, this paper is summarizes in-progress research. The researcher is yet to complete the data analyses and make observations. Thus, herein we state the expected outcomes with the respective analyses ranging from construct validation, model testing, and model application. This section concludes with a summary of implications for research and practice.

The formative expert model (as per figure 2) employs new constructs that necessitates a range of model validation tests. As per formative construct validation procedures described by (Diamantopoulos and Winklhofer 2001), Variance Inflation Factors (VIF)⁴ will be first computed separately for each of the 18 expertise measures to assess the possible existence of multicollinearity between formative measures. The measures with VIF scores below the common threshold of 10⁵ will be retained for further analysis (as recommended by (Kleinbaum, Kupper et al. 1998)). A similar procedure will be followed for the IS-Impact measurement model. Once the absence of multicollinearity of items is established, a MIMIC model will be developed and tested following prescriptions of Jarvis et al (2003, p.214, Figure 5, Panel 3) to observe the Goodness of Fit indicators. Finally a PLS model will be developed using the 18 items together with their respective criterion measures to test the strength of the model and its stability. It is expected that aforementioned analyses will provide a stable model with appropriate indicators. Once the validated expertise items are identified, following prescriptions of Vygotsky (1962) and Eriksson et al. (1994) all items per respondent will be aggregated to a new variable. This will allow researchers to establish the standard deviations for each respondent for each construct and the overall construct of expertise. Based on the aggregated score and their standard deviations, we can now determine whether a respondent is an expert, intermediate or a novice.

⁴ The VIF as suggested by is often criticized as being not adequate for assessing multicollinearity, O'Brien, R. M. (2007). "A Caution Regarding Rules of Thumb for Variance Inflation Factors." *Quality and Quantity* 41(5): 673-690.

However a range of other tests are expected to compensate for this deficiency, Belsley D.A., K. E., Welsch R.E. (1980). *Regression diagnostics*. New York, J. Wiley.

⁵ The largest VIF for the study measures being 6.1.

In order to test the validity and application of the three level continuum of expertise, we will then observe the 'evaluation scores' for each respondent. To statistically determine whether a respondents hold diverse views on the success evaluation criteria, a series of independent sample t-tests will be carried out using the, aggregated scores of the four success dimensions and its variants. Observing statistically significant differences will provide further evidence of the validity (and existence) of the three levels of expertise.

This research has the potential to demonstrate a range of implications to research as well as to the practice. Identification of generalizable characteristics of experts of Information System will be a starting step with substantial impact on most sub-disciplines. Specifically for Information System success research, the characteristics of an expert of IS, will add much more confidence in system evaluations. From management practice, identification of expert characteristics will allow organizations to emulate qualities of experts to novices and intermediates. Moreover, the simple identification of cohorts based on their expertise will allow organizations to allocate practices, training and resources according to the areas of need.

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